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## U. S. DEPARTMENT OF AGRICULTURE.

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FARMERS' BULLETIN No. 227.

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# Experiment Station Work,

## XXX.

Compiled from the Publications of the Agricultural Experiment Stations.

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TOP-DRESSING GRASS LAND.  
EXTENSION OF CORN GROWING.  
PEANUTS FOR FORAGE.  
WINTERKILLING OF FRUIT TREES.

CRANBERRY CULTURE.  
LIME-SULPHUR-SALT WASH.  
DESTROYING PRAIRIE DOGS.  
CLEAN MILK.

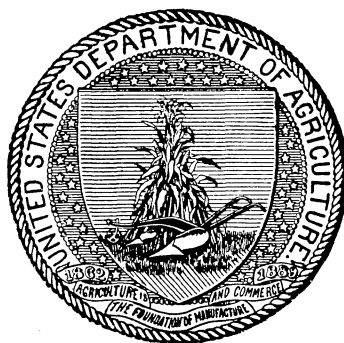
POULTRY HOUSES.

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PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Director.

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# EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

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Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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# EXPERIMENT STATION WORK.<sup>a</sup>

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## TOP-DRESSING GRASS LAND.<sup>b</sup>

Grass lands require special fertilizer treatment. After the meadow has been established on land of good fertility and in good tilth and crops of hay are removed each year, the original supply of plant food is diminished and the productiveness of the meadow necessarily decreases. In order to maintain its profitable yielding capacity the supply of plant food must be kept up through fertilization. The method of applying fertilizers presents some difficulties which are not encountered in fertilizing the soil for most of the other crops. The grass remains upon the land continuously for a series of years and there is no opportunity for plowing under green manure or applying barnyard manure or commercial fertilizers and incorporating the same into the soil from the time one crop is removed until the succeeding one is put in, as can be done in the culture of annual crops. Furthermore, the coarser undecomposed material of barnyard manure which remains upon the meadow is likely to be raked up with the hay, which is a decided disadvantage, and the manure sometimes also has the effect of reducing the quality of the grass by causing a rank growth and by the introduction of weeds. The use of commercial fertilizers on meadows has the advantage of leaving the barnyard manure produced on the farm available for other crops, to which it can be more readily and satisfactorily applied. If barnyard manure is to be used on a meadow it should be applied as a uniformly fine and well-rotted compost.

For the different reasons given, and also on account of the greater availability of the plant food they contain, certain commercial fertilizers are better adapted to top-dressing grass lands than barnyard manure. The farmer must know, however, the kinds and quantities of fertilizers best suited for this purpose, at what time the application should be made, and whether under ordinary conditions he may

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<sup>a</sup> A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

<sup>b</sup> Compiled from Rhode Island Sta. Buls. 57, 71, 82, 90, 103.

expect a profitable return. These questions have been studied by the Rhode Island Station in an experiment extending over a period of six years, and the results obtained are here briefly summarized.

The experiments were begun in 1899 on three plats, numbered 17, 19, and 21. Since 1893 these plats had been devoted chiefly to the growth of leguminous crops and had received annually 180 pounds of muriate of potash and a quantity of phosphoric acid approximately equivalent to an application of 1,200 pounds of acid phosphate containing from 13 to 14 per cent of available phosphoric acid. During this same period plats 19 and 21 received each year 150 and 450 pounds of nitrate of soda per acre, respectively, while plat 17 received no nitrogen and had probably not received this element for from 15 to 20 years. In 1897 all plats were treated with 1 ton per acre of slaked lime. In 1898 7.5 pounds each of common red clover and redtop and 15 pounds of timothy per acre were sown, with barley as a nurse crop. The yields of hay obtained in 1899 were as follows: Plat 17, 5,075 pounds; plat 19, 6,300 pounds, and plat 21, 6,913 pounds per acre. The hay from the no-nitrogen plat consisted almost entirely of clover, while the crop from the other two plats was largely redtop and timothy. The results of this season indicated that large crops of grass require considerable quantities of immediately assimilable nitrogen applied early in the season, and that good crops of clover can be grown on limed land without supplying nitrogen in the form of commercial fertilizers. Allowing 20 per cent for shrinkage in the hay and estimating the value of the different crops at from \$9 to \$15 per ton, plat 17 gave a difference of \$6.09 per acre over the cost of the fertilizer applied; plat 19 a difference of \$14.34, and plat 21 of \$19.62.

In 1900, soon after the grass started to grow, all plats received the regular dressing of potash, phosphoric acid, and nitrogen, but in 1901 the fertilizer application per acre was changed to 807.5 pounds of acid phosphate, containing 130 pounds of phosphoric acid; 200.52 pounds of muriate of potash, furnishing 100 pounds of potash, and 133.52 pounds of nitrate of soda on plat 19 and 400.56 pounds on plat 21, supplying 21 and 63 pounds of nitrogen, respectively.

Throughout the entire experiment plat 17 received no nitrogen; plat 19 a one-third ration, and plat 21 a full ration. The results obtained with the modified application emphasized the need of properly adjusting the quantities of the different elements given in the fertilizer application. The reduction of the nitrate of soda from 450 to 400.56 pounds and of the acid phosphate from 1,200 to 807.5 pounds and the increase of the muriate of potash from 180 to 200.52 pounds reduced the cost of the application and resulted in higher profits. The treatment of the plats in 1902 was essentially the same as the year before, with the exception that the quantity of muriate of potash was raised

to 303.26 pounds, furnishing 150 pounds of actual potash per acre. During the last two years of the six-year period the fertilization was the same as in 1902. The principal data secured in the experiment are shown in the following table:

*Results obtained in a six-year fertilizer experiment on grass land at the Rhode Island Station.*

| Year.         | General applica-<br>tion. |                          | Plat 17, no<br>nitrogen. |   | Plat 19, one-<br>third ration. |   | Plat 21, full<br>ration. |   |
|---------------|---------------------------|--------------------------|--------------------------|---|--------------------------------|---|--------------------------|---|
|               | Potash.                   | Phos-<br>phoric<br>acid. | Hay<br>per<br>acre.      | Value<br>of crop<br>over fer-<br>tilizer. | Hay<br>per<br>acre.            | Value<br>of crop<br>over fer-<br>tilizer. | Hay<br>per<br>acre.      | Value<br>of crop<br>over fer-<br>tilizer. |
|               | <i>Pounds.</i>            | <i>Pounds.</i>           | <i>Tons.</i>             |   | <i>Tons.</i>                   |   | <i>Tons.</i>             |   |
| 1899 .....    | 88.31                     | 164.1                    | 2.54                     | \$6.09                                    | 3.15                           | \$14.34                                   | 3.46                     | \$19.62                                   |
| 1900 .....    | 90.38                     | 191.1                    | 2.00                     | 13.42                                     | 2.80                           | 20.37                                     | 4.10                     | 30.40                                     |
| 1901 .....    | 100.00                    | 130.0                    | 1.65                     | 12.13                                     | 2.78                           | 23.97                                     | 4.70                     | 40.70                                     |
| 1902 .....    | 150.00                    | 130.0                    | 1.48                     | 7.44                                      | 2.43                           | 16.52                                     | 4.10                     | 32.74                                     |
| 1903 .....    | 150.00                    | 130.0                    | 1.64                     | 7.70                                      | 1.85                           | 9.38                                      | 3.83                     | 27.81                                     |
| 1904 .....    | 150.00                    | 130.0                    | 1.25                     | 3.60                                      | 2.05                           | 10.71                                     | 4.07                     | 30.36                                     |
| Average ..... |                           |                          | 1.76                     | 8.40                                      | 2.51                           | 15.88                                     | 4.03                     | 30.27                                     |

The results for the six years show that without nitrogen an average of 1.76 tons, with one-third the full application 2.51 tons, and with the full application of nitrogen 4.03 tons of field-cured hay was secured per acre. A satisfactory stand of timothy was maintained for the six years only on the plat which received the full ration of nitrogen, and this plat also produced the highest market grade of hay. It was found that where the full ration of nitrogen was given a ton of field-cured hay removed from the soil 32 pounds of potash, 13.1 pounds of nitrogen, and 6.5 pounds of phosphoric acid. In each of three years in which determinations were made more nitrogen was supplied in the full ration than was removed by the crop. With potash and phosphoric acid alone the value of the crop per acre exceeded the cost of the fertilizers on an average per year by \$8.40; with one-third the full nitrogen application, by \$15.88, and with the full application of nitrogen by \$30.27. Determinations of the shrinkage in barn-curing hay showed that it ranged from about 13 to 19 per cent.

For three years an experiment was conducted on two plats to determine the best quantity of phosphoric acid to be applied per acre. An average annual yield of 4.16 tons of barn-cured hay was obtained where 40 pounds of phosphoric acid was applied, and 4.54 tons of field-cured hay where 60 pounds was used. A potash test was conducted on the same plan. The average annual yield of field-cured hay where 150 pounds of potash were used was 5.1 tons per acre, and where 200 pounds were used 5.3 tons.

The data derived from the experiments show that good financial returns may be obtained from grass culture with the use of commer-

cial fertilizers alone. The use of 400 to 500 pounds of acid phosphate and 300 to 350 pounds of muriate of potash and nitrate of soda per acre, applied from April 15 to 25, is suggested as being best adapted for use as an annual top dressing on grass lands where a good stand of timothy and redtop already exist, where a too great degree of soil acidity does not prevail, and where commercial fertilizers only are used.

### **EXTENSION OF THE CORN-GROWING AREA.<sup>a</sup>**

Several of the experiment stations, especially those of the Northwestern States, have given much attention to the question of the extension of the limits of successful corn culture, and have shown that by careful selection of varieties and modified methods of culture suited to the conditions this crop may be successfully grown in regions heretofore considered entirely unsuited to corn culture. This work is proving of great value to those regions in increasing the available supply of food and forage.

In view of the increasing interest in corn growing in Idaho, G. A. Crosthwait, of the Idaho Experiment Station, has prepared a bulletin stating the need of extension of corn growing in Idaho and giving brief directions regarding methods of culture suited to that region. Some of the reasons why an extension of corn culture in Idaho is recommended are stated as follows:

(1) It is needed in our rotations. Wheat can not be raised on the same ground continuously. Many farms in Idaho are becoming less fertile than formerly from this very cause, and a change must be made. A systematic and rational rotation should be practiced. Wheat should be followed by some rotation crop, such as clover, and this by corn. Wheat could then again be sowed and the rotation repeated. Each crop might be raised two years. This makes a simple and effective rotation, and one that would greatly benefit most of our land. (2) Corn would be a very valuable addition to our feeding operations for working animals, fattening animals, and dairy animals. (3) It is also needed for human food. Corn is being shipped in for grinding into corn meal. (4) In the minds of those who have studied the matter there is no longer any doubt that corn can be profitably raised in many sections of Idaho. The average yield in the State in 1903 was 34.5 bushels per acre, 1 bushel higher than that of any other State in the Union.

The following directions regarding methods of culture suited to Idaho and regions with similar conditions are given:

**Selection and test of seed.**—If seed must be purchased, it should be that which has been raised under climatic conditions similar to those under which the crop is to be grown. The seed having been decided upon, the best ears should be carefully selected. As a rule, average-sized ears with deep grains closely set upon a small-sized cob should be selected.

Take a few grains from different parts of the ear and plant them in a box of

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<sup>a</sup> Compiled from Idaho Sta. Press Bul. 5, n. ser.

moist soil, sand, or sawdust, setting the box in a moderately warm place. If all the grains taken from any ear do not sprout in a week, it is better to discard that ear.

**Preparation of seed bed.**—Next in importance to the selection and testing of seed, if, indeed, it is not of equal importance, is the preparation of the soil for the reception of the seed. Certain it is that no subsequent efforts can atone for lack of preparation before planting. Where it can be done it is usually best to plow the ground in the fall. In this way, the soil is in a condition to absorb the rainfall instead of allowing it to run off. The frosts of winter and the action of the atmosphere tend to crumble the soil and to cause the organic matter in the soil to disintegrate and become available as plant food. Many enemies of the corn are destroyed, such as cutworms and grubworms. The soil may be worked earlier in the spring as the surface is drier than that of soil not plowed, although there may be more water in the lower layers of soil. A cover crop sown in the fall after fall plowing and turned under in the spring is beneficial. Rye is a good cover crop and may be grazed when the ground is not too soft. (A heavy clay should not be plowed in the fall, if the winter rains are excessive, as the soil will run together and become compact.) As early in the spring as the ground is dry enough to work, the soil should be disked and harrowed to retard the evaporation of the moisture. The soil should be kept in good condition until planting time, no crust being allowed to remain, as it will permit the moisture to escape. If the soil is properly cultivated there will be no clods to contend with and the seed bed will be soft and mellow for the reception of the seed. A quick germination and a rapid growth are thus assured.

**Time and manner of planting.**—It is best to plant as soon as danger of frost is over, especially in those parts of the State where the frosts of autumn come early. It is better to risk a spring frost than one in the fall, as the corn can recover from a rather severe frost in the spring, if the nodes or joints are not above the surface. The seed should be planted deeply enough to be in moist soil, but no deeper. Shallow planting is preferable to deep planting, if conditions permit. The thickness of planting will depend upon the size of the variety, the moisture available, and the fertility of the soil. If checked, probably  $3\frac{1}{2}$  feet apart each way with two or three grains per hill will be right for ordinary Idaho conditions, or the equivalent if not checked.

**Cultivation.**—If the soil is in proper condition at planting time, the subsequent care of the crop is ordinarily a simple matter. If the soil is kept in good tilth and free from weeds, the farmer has done all he can do in the way of cultivation. A weeder or light harrow may be used just as the corn begins to appear and once or twice more before it becomes too large. This is very important in securing the two conditions mentioned above. The cultivator may then be used several times, care being taken not to cultivate so deeply as to injure the small roots so essential to the growth of the plant. Cultivation should not cease because a certain time of the year has come or because the corn has reached a certain height. Shallow cultivation to keep a loose soil mulch for the retention of moisture may often be profitably practiced after the stage when cultivation usually ceases. Indeed, the later treatment of the crop often determines the profitableness of corn growing. Even where irrigation is practiced it is better to use less water and to practice better methods of cultivation.

**Harvesting.**—For the silo, corn should be cut when it has passed the roasting ear stage and is entering the glazed stage. For fodder, it should be cut as near the maturity stage as it can be handled without waste. The husking of

corn for storage in the crib should not begin until the ear is thoroughly matured. This is particularly important in those parts of the State where the fall and winter months are very wet.

### CULTURE OF PEANUTS FOR FORAGE.<sup>a</sup>

The peanut is a valuable leguminous plant for the South.<sup>b</sup> According to the Twelfth Census, the area devoted to peanut culture increased from 203,946 acres in 1889 to 516,658 acres in 1899, or an increase of 153.3 per cent, while the total production increased 233.5 per cent during the same period. These data show how the crop has grown in popularity, and has kept abreast with the greater market demands for the nuts. The market supplies are furnished mainly by the South Atlantic States, together with Alabama and Tennessee. The extension of peanut culture for market purposes can not be especially advised, but in many localities the crop can be grown to good advantage, and is deserving of more attention for forage and soil renovation. The Arkansas Experiment Station has grown peanuts for a series of years, and in a recent bulletin has given a summary of its observations on the culture and uses of the plant for stock food, together with recommendations for growing the crop more extensively for this purpose in Arkansas.

Attention was mainly given to the Spanish peanut, a small but prolific variety, well adapted to a wide range of well-drained soils, and succeeding well in the sandy pine flats, the rich alluvial river bottoms; the prairie regions, and the mountain sections of this State. This variety has been observed to make a good growth and give profitable returns wherever the cowpea can be grown with success. On some of the worn and infertile sandy lands of the State it has produced greater yields of grain and forage than corn, and has proved a more reliable crop.

A light or gray sandy soil is recommended for all varieties, but dark or clay soils containing sufficient lime, and soils treated with barnyard manure or green manures are considered suitable when the crop is grown for forage or for grazing. It is suggested that the soil be prepared as for corn, but with the surface in a finer and mellow condition. At the station the seed has been planted on the level ground and covered not more than 1 inch deep if moisture conditions were favorable, or about 2 inches deep when planted late in dry weather. The seed is generally shelled before planting, but the Spanish variety is sometimes planted without shelling, or by simply breaking the pod in two parts. In one experiment the station

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<sup>a</sup> Compiled from Arkansas Sta. Bul. 84.

<sup>b</sup> Consult U. S. Dept. Agr., Farmers' Bul. 25, for general discussion of culture and uses of peanuts.

obtained 84.4 per cent of a stand from shelled nuts and 95.1 per cent from nuts only broken in two. In a germination test shelled nuts gave a germination of 98 per cent; pods broken in two, of 91 per cent; and whole pods, of 78 per cent. Whole pods were very slow in sprouting, while broken pods grew quicker, but did not germinate so promptly as shelled nuts. The work of shelling the nuts requires considerable time, but it was found that the Spanish variety can be quite successfully shelled with a cowpea huller, the loss in split seeds amounting to about 20 per cent, being more than compensated for in the time gained. Means for readily separating the broken from the whole seed makes the operation cheaper and more satisfactory. It is advised not to plant before warm weather has set in and is likely to continue; but planting may be done much later, and especially in the southern part of the State, where Spanish peanuts will mature good crops even if planted as late as August 1.

While Virginia and Tennessee varieties are usually planted at distances of from 12 to 18 inches in the drill, the Spanish peanut has been found to give heavier yields from closer planting. The results of experiments made by the station show that Spanish peanuts should be planted in rows  $2\frac{1}{2}$  feet apart, with the seed from 4 to 12 inches apart in the row.

The methods of culture usually practiced with corn, cotton, cowpeas, and potatoes are also recommended for peanuts. Shallow cultivation should be given frequently, and if the soil is in good physical condition it need not at any time be stirred deeper than 2 inches. The later cultivation should always be shallow. Covering the blossoms with soil is injurious, and experiments in determining the effects of covering the vines when in blossom resulted in a marked decrease in yield, due to the practice.

Peanuts grown for market purposes require more care in harvesting than a crop grown for stock food. As for all crops requiring curing, dry, sunshiny weather is best adapted to this part of the work. In order to prevent loss by sprouting of the ripe nuts, harvesting should be done soon after the first formed pods have matured. The plants are generally loosened in the soil by means of a plow running sufficiently deep and constructed to cut the tap root without tearing the nuts from the vines. When the plow has been run along the rows in the forenoon, the vines are usually gathered in the afternoon of the same day, three or four rows being thrown together. They are then either placed in small cocks or allowed to remain in the windrow, and when partly wilted are stacked about poles and left to cure from two to four weeks until ready for picking. "The plan usually followed at the station has been to allow the vines to remain several days in cocks or windrows. At intervals of two days

these cocks or windrows are turned over, exposing the undersurface to the drying effects of the sun. When the vines have become thoroughly cured, they are hauled to the barn and spread in as thin layers as the barn space will allow and turned occasionally until thoroughly cured." The highest yield of nuts, 143.5 bushels per acre, was secured by the station from the Spanish variety grown on a rich garden soil, while on ordinarily fertile soil of calcareous and siliceous formation, which is well adapted to the crop, the Virginia white variety yielded 113.6 and the Spanish 109.09 bushels per acre.

The numerous estimates made by the station as regards the yield of hay from a crop of peanuts varies from 1 to very near 3 tons per acre. This hay is usually worth at least \$10 per ton, and may be considered a by-product when the nuts are harvested for market. When the Spanish variety is grown for the purpose of being grazed by hogs, the hay may be mown before the hogs are turned into the field, or it may be grazed by cattle, horses, sheep, or goats and the hogs then given access to the nuts. \* \* \* Spanish peanuts intended for grazing by hogs may be planted at any time after danger of frost is over on to the first or middle of July in north Arkansas, and as late as the middle of August in the southern part of the State. The time and methods of planting this variety of peanuts for hog feed are quite adjustable, and the crop may be associated with almost any system of cropping practiced in the South. The most profitable practices with this variety consist in growing the peanuts with some other crop, as corn, or after some crop has been harvested. When grains, Irish potatoes, crimson clover, and such crops that are harvested in May and June have been taken off, the same fields may be seeded to peanuts. They may be planted in missing places in the cotton and corn fields between the hills of corn in the rows, or in the middle, as is frequently the custom with cowpeas.

### WINTERKILLING OF FRUIT TREES.<sup>a</sup>

About once in each decade, and sometimes oftener, a severe winter occurs in which an unusually large number of fruit trees are killed. An examination of the orchards after such winters shows many irregularities as to the extent of the injuries in orchards differently located and managed. Some varieties of fruits are uniformly less hardy than others, and the winter injury to these sorts may be traced directly to their greater tenderness. On the other hand, trees normally perfectly hardy in a locality may suffer serious injury or be entirely killed during such "test" winters, while other trees of the same varieties in the same orchard may escape injury entirely. During the prolonged cold winter of 1903-4 great losses were suffered by orchardists in the Lake Erie peach belt. Some orchards were entirely destroyed; others were apparently uninjured and came through the winter in a vigorous, hardy condition; and still others, while suffering severely, yet contained sections, rows or parts of rows, or individual trees that came through the winter uninjured.

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<sup>a</sup> Compiled from Ohio Sta. Bul. 157.

Many theories were advanced by the orchardists as to the cause of these anomalies, and as many contradictions appeared. The theory of insufficient drainage, which might be advanced as the cause of the injury in one orchard, would receive direct refutation in the next. If an orchard on elevated ground escaped in one instance it might be partially or entirely killed in another. In order to learn the cause of these irregularities, the horticulturist of the Ohio Experiment Station and his assistants visited both injured and uninjured orchards in Catawba Island and the peninsula of eastern Ottawa County, in Ohio, and made a thorough study of the matter, reporting the results of their investigations in a recent bulletin of the station.

Their investigations show that while a general or direct cause of the injury was, of course, the severe and long-continued cold the specific causes of the varying degrees of injury were exceedingly numerous. Generally speaking, it was found that where the vitality of the tree or orchard had been lowered by any cause whatever during its previous history the chances of injury to the tree by the cold were by so much increased. Factors observed in different orchards which contributed to low vitality in the trees were an insufficient degree of fertility, a low physical condition of the soils, prevalence of San José scale, leaf curl, peach-tree borers, extremely dry condition of the ground in some sandy and gravelly ridges, "water-logged" soils, etc.

**Injury on bare ground.**—There was a marked contrast in the extent of the winter injury on bare soils—soils given clean cultivation—and on covered soils. The bare soils froze deeper and the injury was much greater than on soils covered with a mulch or other material. The greater depth to which bare soils freeze in winter than covered soils was brought out in an experiment made at the station. A plat of peaches in an exposed situation was selected and a strip of sod 10 to 12 feet wide removed from one row, leaving the bare surface of the soil fully exposed to the cold. Another row alongside was left in grass which had been clipped and allowed to lie upon the ground.<sup>a</sup> Where the sod was removed the ground froze to a depth of 18 inches, while under the thin sod covering of grass and weeds in the other row the ground froze to a depth of about 8 inches. The trees in the bare ground "were very slow in starting into growth the following spring of 1904. All of the trees in this row were seriously injured by the cold, many large branches dying, while in one case the entire tree was so badly injured that but few leaves appeared throughout the season, and these upon shoots so feeble and slender that the tree might well be considered dead. Later in the season, however, some of the trees rallied slightly, though all showed a serious lack of

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<sup>a</sup> See U. S. Dept. Agr., Farmers' Bul. 202, p. 11.

vitality. The trees in the sod \* \* \* did not suffer in the least degree—all making a healthy, uniform growth during the season of 1904.”

**Value of cover crops.**—The value of an annual cover crop as compared with clean cultivation was found in an orchard eighteen years planted, one-half of which had been cultivated during the first half of each season and then sown to crimson clover, while the other half was given clean cultivation during the growing season. “Upon the clean culture area there was a much greater percentage of injury from the cold of the winter than upon the crimson-clover section. Where the clover crops had been grown and plowed down the trees showed remarkably healthy, heavy, dark-green foliage, contrasting sharply with the yellowish, sickly foliage of the clean-culture plat.” Another grower in the injured-peach region stated that “not a single orchard or section of an orchard of which he knew, that had received even a light dressing of barnyard manure within the last year or two, had suffered noticeably from cold.”

**Injury in scale-infested orchards.**—A 13-year-old orchard of 660 trees was found located on shallow limestone soil covered with a dense, heavy growth of bluegrass. The San José scale had wrought havoc in the neighborhood, but it had been kept under control in this orchard by spraying. As a result, not a tree in the whole block was killed by cold. Across the road from this orchard was another, located on similar soil and also in sod, but in which the scale had not been controlled. “The story is told in two words—entirely dead.”

**Injury from leaf curl.**—Another instance is cited in which an orchard was sprayed in the spring of 1902 for the control of the scale, with the exception of three rows through the middle, which were overlooked. As a result, the scale increased rapidly during this season on these unsprayed trees, and they were also attacked by leaf curl, which practically defoliated them. The whole orchard was sprayed in 1903, nevertheless the trees had been so weakened by the leaf curl of the preceding year that the good care given them in 1903 was unavailing, and every tree in the three rows was killed, while every tree on either side of them which had been sprayed came through the winter sound, vigorous, and healthy.

**Benefits from banking trees.**—A simple, easy, and very effective method of preventing winterkilling of peach trees was observed in the orchard of one grower. Just before winter set in this grower hauled manure to the orchard, but instead of scattering it beneath the trees in the usual way he banked a very few forkfuls immediately around the stem of the tree. When the supply of manure ran out peat or earth was hauled into the orchard and banked around the stem of the tree in the same manner. “The results from the use of these

materials were uniform, and, surprising as it may seem, every tree that received this simple treatment survived the winter without the least injury from cold, while the few trees and sections of rows left here and there unbanked and serving as 'checks' in the experiment died almost to a tree." Another orchard of some 500 trees a little farther to the west of this orchard, "which had received the same high culture and good care, with the exception of the simple banking process, was almost a total loss." The trees in these orchards were extremely vigorous and had made a rank growth, which made them peculiarly susceptible to injury by freezing.<sup>a</sup>

**Orchards in sod.**—On the same farm trees on a piece of ground which was so stony that it could not be cultivated and which was kept in bluegrass sod, with a heavy mulch of coarse material, such as cornstalks, barnyard manure, etc., about the stems, according to the true "sod-and-mulch" method, came through the winter without injury.

These investigations bring out strikingly the necessity of such continuous and thorough cultural practices in the orchard as shall maintain the trees at all times in a vigorous, healthy condition. The fertility and vegetable matter of the soil must be maintained by the addition of manure or the growing of cover crops. Spraying to control insect pests and fungus diseases must be thorough and unremittent. Trees on undrained or very rich soil, trees weakened by overbearing or by borers, all alike invite winter injury. Cover crops and mulches protect the ground from deep freezing and resultant winter injury. Sod serves the same purpose. Banking up the trunks with a few shovelfuls of manure or earth appears to have a marked favorable influence.

### CRANBERRY CULTURE.<sup>b</sup>

As a recent Farmers' Bulletin<sup>c</sup> by L. C. Corbett, of this Department, shows, cranberry raising has from a very small beginning grown to be an industry of the first magnitude and receives more or less attention in 19 States. According to the census of 1900 the total area in cranberries was 20,364 acres, yielding a product of 977,516 bushels; Massachusetts standing first with 598,906, New Jersey second with 230,221 bushels, and Wisconsin third with 111,098 bushels.

Several of the experiment stations have given more or less attention to the subject. The Massachusetts and New Jersey stations

<sup>a</sup> For relation of cultivation to winterkilling see U. S. Dept. Agr., Farmers' Bul. 202, p. 12.

<sup>b</sup> Compiled from Wisconsin Sta. Bul. 119; West Virginia Sta. Bul. 86.

<sup>c</sup> U. S. Dept. Agr., Farmers' Bul. 176. For information regarding cranberry insects and diseases see Farmers' Buls. 178 and 221.

have made thorough studies of insect enemies and fungus diseases of cranberries and the management of bogs to control or repress injuries from these sources, and the West Virginia Station has reported successful attempts, under the direction of L. C. Corbett, to grow cranberries in the mountain swamps of that State.

The Wisconsin Station has been carrying on investigations with cranberries during the past two years in cooperation with the Office of Experiment Stations of this Department. A recent bulletin of that station presents a detailed account of this work, which contains matter of general interest.

**Frost protection.**—Untimely frosts, which occur practically every month of the growing season in Wisconsin, often seriously injure the crop. On the night of August 8, 1904, frost ruined about 60 per cent of the fruit in Wisconsin, causing a loss of approximately \$200,000. A number of local factors have been observed which have an important bearing on frost prevention. It has been noticed that frost often does not occur uniformly over a broad, level moorland, but forms in patches. These frost patches occur where the marsh is poorly drained or covered with weeds, grass, and moss, while clean, well-drained, or sanded land often escapes. It appears that the solar heat absorbed and radiated by a clean, sanded bog is considerably greater than by a bog covered over with a mat of grass. During the months of July and August there was a variation in the minimum temperature of as much as  $13^{\circ}$  in favor of the bare, sanded bog. On the bog covered with clean vines also the minimum temperature was uniformly a little higher than on a bog covered with a sort of blanket of dead grass and growing vegetation.

The data given in comparison of the temperatures over bare, sanded bog, and bog covered with grass and growing vegetation, showing a difference in temperature in favor of the sanded bog, can not be considered to mean that the covering in the one case was the sole cause of difference.

The low specific heat of sand and the consequent high heating of it during days of sunshine, and also the lack of evaporation over its surface because of the lack of capillarity in bringing water to the surface, render it especially valuable as a conserver of heat. It will thus be seen that sanding and freedom from weeds, grasses, or any form of useless vegetation over the bog are two very important factors in protection from frost.

There is a third condition, and one wholly within the control of all cranberry growers, which is perhaps of greater importance than all the others together as a means of frost protection—that is, drainage. The effect of thorough drainage by the use of deep and close ditches in aiding in protection from frost can hardly be overvalued. The State Experiment Station has gone through the past summer, in which there were several frosts and one or two very hard frosts, without any loss from freezing whatever, notwithstanding the fact that certain parts of the bog were not flooded once during the season. On other adjoining marshes flooding was resorted to many times during the summer for protection, and yet a loss of about 60 per cent of the total crop

was sustained on the morning of August 8. While this protection at the station was not due to good drainage alone, there is no doubt that it had much to do with warding off the frost. And the three conditions above mentioned—that is, good drainage, sanding, and freedom from excessive vegetation—are the only conditions which could account for this extra protection to the station. \* \* \*

The sole means used heretofore throughout the State of Wisconsin for protection against frost has been that of flooding the marshes with water. This method, where the system for handling the water is so arranged that it may be done rapidly, and where the temperature of the water is sufficiently high, is a very efficient method, and will doubtless always remain the surest protection against severe frosts, but it may often be used, and undoubtedly is oftentimes used to the very serious damage of the crop. This, of course, means a thorough flooding of the marsh or a flooding where it is necessary to put the berries under water. However, such heavy flooding is only necessary during the latter part of the season, when we are subject to hard frosts, and this method of protection may be well and safely used for the occasional and untimely frosts of summer. At such times it is seldom necessary to raise the water over the surface, especially if the flooding ditches are close together, for the high temperature of the water at this season and its high specific heat may make a small amount ample for light frost protection. \* \* \*

The size and depth of the ditches used in conveying the water from the reservoirs and spreading it over the planting are of great importance, especially on nights of quick, heavy frosts, when it is necessary to flood as rapidly as possible. There should be one or more large main ditches extending from the reservoir through the planting, coming in contact with each section, so that each may be flooded independently. \* \* \*

If the greatest efficiency would be had in flooding, the canal should be so constructed that the full head of pressure in the reservoir may be carried to the end of the flooding canal. In this case the canal might be kept filled during the season of probable frost, the only extra loss of water being that which would come from the extra surface presented for evaporation and the seepage through the side dam, an amount of little consequence in large systems. In at least three instances in Wisconsin this year crops were damaged to the extent of many thousand dollars because of the insufficient capacity of the flooding canals. In each case the expenditure of a few hundred dollars would have constructed good substantial canals of ample capacity for flooding at all times.

**Sanding and weeding bogs.**—Relative to sanding at the Wisconsin Station, “observations on newly planted marsh, both sanded and unsanded, would go to show that the unsanded bog promoted a more rapid and vigorous growth of vines, at the same time promoting a more rapid and vigorous growth of weeds. While there is no doubt as to the great value of sanding, the question of the time of sanding must be decided by each marsh owner for himself, it being a question between the extra expense of weeding on the one hand and the apparent slower growth of vines on the other.”

After a bog has been prepared and planted many growers leave it without much further attention, as a result of which it is soon over-run with grass. By thorough weeding and good drainage the vines

at the experiment station produced at the average rate of 62.5 barrels per acre, while the average yield per acre for the State during the same year was less than 5 barrels, a result which is decidedly in favor of the well-prepared and well-cared-for marsh.

**Liming.**—Experiments at the Wisconsin Station were made on the liming of cranberries, both quicklime and marl being used. The applications were made in June. At the end of the season no effect of the lime could be observed on the growth of the young plants. Liming the American Belle variety at the Rhode Island Station, however, proved positively injurious.

**Harvesting.**—The effect of time of harvesting on yield was also investigated at the Wisconsin Station. Harvesting in Wisconsin usually begins the forepart of September, no matter what the condition of the crop. In the test, berries were picked on September 8, 24, and October 8. "The growth during the 30 days showed an increase in size of 19 per cent, 10 to 11 per cent being realized during the first 16 days and the rest of the growth between September 24 and October 8. It will thus be seen that almost 19 per cent clear profit on a crop would have been realized could the picking have been deferred 30 days."

**Grading cranberries.**—After harvesting, cranberries are graded according to size and quality. The Wisconsin Station describes a very successful apparatus for this purpose. The berries are first poured in the hopper of the machine, from which they pass through a fan blower, which takes out the chaff, etc. They then fall into several bottomless V-shaped troughs. The opening in the bottoms of the troughs gradually widens with the length of the troughs. The berries fall through the troughs at different places, according to size, into separate compartments. From these compartments each grade of berries is carried over a series of "jumpers," which grades them according to firmness and quality. These "jumpers" consist of a series of steps.

The surface of the steps is made of glass or highly polished hard wood, and the good berry striking upon this hard polished surface rebounds and, if the force is sufficient to raise it over the curtain hung in front of and a little above the surface of the step, it falls over the outside of the curtain and passes down into the box with the good berries. A series of these steps are so arranged one below another that the berry has several chances of jumping over the curtains and may get several bruises before it finally reaches the box with the good berries. The poor, soft, and bruised berries, being unable to rebound because of a lack of elasticity, slide from one step to another, finally reaching the bottom and sliding out under the curtain into the slush box. If any such rough methods of handling were used on the apple or any other fruit, the keeping quality would be entirely destroyed, and it is only the very high keeping quality of the cranberry that brings it through this method of handling and still makes it the best keeping fruit that we have.

That this process of jumping does injure the keeping quality of the berries is shown by the fact that the berries "used for study at the station always show the first signs of decay on those spots bruised in going over the jumpers."

**Storage.**—Relative to storage, the Wisconsin investigations show that berries stored in a wet condition do not keep well. A sudden change in temperature from a cold to a warm, moist atmosphere is also injurious to the keeping quality, due to a deposit of moisture on the berries, which not only affects their physical condition, but permits of the rapid growth of disease-producing fungi and bacteria on the fruit. In the season of 1903, berries picked early in the season kept better than those picked later. The poorer keeping quality of the late-picked berries in this instance is thought to be due to the wetness of the fall and the consequent greater exposure of the late-picked samples to moisture and cold nights rather than to the extra ripeness of the berries. In 1904, the late-picked berries kept decidedly the best, and this result seems to be in accord with that of cranberry growers generally.

#### **LIME-SULPHUR-SALT WASH.<sup>a</sup>**

This insecticide in one or another form has for years been relied upon by the fruit raisers of the Pacific coast States in combating San José scale and other scale insects. The experience of western fruit growers with the remedy has been very satisfactory. On account of the demonstrated efficiency of the lime-sulphur-salt wash in California, Oregon, and Washington preliminary tests were made in the East by the Bureau of Entomology and by other investigators to determine its value under eastern conditions. The first results obtained from these experiments were not satisfactory, but later experiments have yielded such gratifying results that the remedy is now widely used and recommended by the Bureau of Entomology and various experiment stations, particularly in Illinois, New York, Ohio, Connecticut, New Jersey, and Maryland. The chief advantages which this wash seems to possess are that it is highly effective in the destruction of the San José scale, other scale insects, plant lice, and other similar pests. It also controls to a large extent the development of certain fungus diseases, such as peach-leaf curl. The remedy may be applied during the dormant period of fruit trees, and therefore

<sup>a</sup> Compiled from Connecticut State Sta. Bul. 146; Illinois Sta. Circ. 85; Maryland Sta. Bul. 99; New Jersey Stas. Bul. 162; New York State Sta. Buls. 182, 228, 247, 254; Ohio Sta. Bul. 144; U. S. Dept. Agr., Farmers' Bul. 127; U. S. Dept. Agr., Bureau of Entomology Bul. 46; North Carolina Dept. Agr., Ent. Circ. 13.

with comparative safety to the trees. It may be made at home of materials of known purity and is comparatively inexpensive.

A great many variations have been made in the formula of this wash for the purpose of determining, so far as possible, which are the effective insecticide elements in the wash and in what proportion the combination is most effective. In experiments of this sort at the Connecticut State Station in 1904, 15 formulas were tested containing lime and sulphur in one form or another. The proportions varied considerably, but in general it was found that a boiled mixture of lime and sulphur containing as much or a little more lime than sulphur was as cheap and effective as any other mixture for commercial orchard work. Some difference of opinion exists regarding the advisability of adding salt to the mixture. Some investigators find the lime and sulphur mixture without the salt as effective as when the salt is added, and therefore omit the salt as a matter of convenience and economy. One of the formulas used at the Connecticut State Station included 14 pounds each of lime and sulphur per 40 gallons of water; another contained 20 pounds of lime for the same amounts of the other ingredients. In Maryland a formula is recommended containing 20 pounds lime, 15 pounds sulphur, 10 pounds common salt, and 50 gallons water. In Illinois the formula recommended by the experiment station contains 15 pounds each of lime, sulphur, and salt per 50 gallons of water. The Ohio Experiment Station recommends 50 pounds each of lime, salt, and sulphur per 150 gallons of water. The formula recommended by the North Carolina department of agriculture contains 20 pounds lime, 17 pounds sulphur, and 10 pounds salt per 50 gallons of water.

In the Eastern States this wash was first used essentially in the form originally recommended by California fruit growers—after thorough boiling. Numerous experiments have been made since that time to determine the proper length of the boiling period, in order to secure the best results. According to recent experiments in Connecticut, New York, Georgia, and elsewhere, it is not necessary to boil this wash for two hours, as has sometimes been recommended, but equally satisfactory results may be obtained by boiling from thirty minutes to one hour. Considerable saving is thus effected in fuel and time. The North Carolina department of agriculture recommends that the mixture be boiled for one-half hour after the lime is thoroughly slaked. Where it is desirable to avoid the inconvenience of boiling by the application of artificial heat, it has been found possible to prepare self-boiling mixtures containing lime, sulphur, and caustic soda. One of the most frequently recommended formulas for this mixture contains 10 pounds lime, 8 pounds sulphur, and 4 pounds caustic soda per 25 gallons of water. In preparing

this mixture the lime is first slaked in hot water, after which the sulphur is added, and later the caustic soda. Water is then added from time to time to prevent the mixture from boiling over and to maintain a liquid consistency. As soon as boiling caused by the chemical action ceases, the amount of water necessary to make the required volume may be added. In the preparation of the fire or steam boiled lime-sulphur-salt wash, it is usually recommended that 4 or 5 gallons of water be brought to the boiling point, after which sulphur is mixed with hot water to form a paste and added to the boiling water. The lime is then added and water is poured in from time to time to prevent the mixture from boiling over. The mixture is stirred until the process of slaking is completed, after which the salt is added. It should then be boiled, as already indicated, for one-half hour or longer.

The lime-sulphur-salt wash was first applied in the Eastern States as a winter or early spring remedy, care being taken to finish the spraying before the buds began to swell. Recently numerous experiments have been tried, particularly in New York and Ohio, in testing the value of the remedy as a fall application. The results of these experiments in New York indicate that the injury from the application of the lime-sulphur wash in the fall was very slight in the case of peaches, plums, and cherries. In some cases the injury was hardly noticeable. As a fall application the lime-sulphur wash, lime-sulphur-salt wash, and lime-sulphur-caustic soda wash were about equally effective. In Ohio the application of the insecticide in the fall was not detrimental to peaches or plums, and the destruction of the San José scale was as complete as when the remedy was applied in the spring.

As a result of the tests thus far made at the various agricultural experiment stations, numerous orchardists have applied the lime-sulphur-salt wash to different kinds of fruit trees on a commercial scale. In Connecticut, during the spring of 1904, about 100,000 trees were sprayed with lime-sulphur mixtures with generally satisfactory results. In the Southern States, according to the North Carolina department of agriculture, "the lime-sulphur-salt wash bids fair to become popular as a winter spray for orchards, not only as a remedy for the San José scale, when that pest is present, but also on account of its general effect on the tree in removing dead bark, destroying hibernating spores of fungus diseases, checking scurfy scale, oyster-shell scale, and to a certain extent other insect pests." During the winter of 1904 the lime-sulphur-salt wash was applied in North Carolina to about 75,000 trees and with excellent results. The Illinois Experiment Station, one of the first to recommend the use of lime-sulphur-salt wash under eastern conditions, refers to the problem

of eradicating San Jose scale by means of lime-sulphur washes, as follows:

The very extensive practical and experimental work of this office for the destruction of the San José scale, carried on during the past four years, has now demonstrated the possibility of keeping this insect in check by an occasional treatment, and indeed of almost completely clearing an infested orchard under fairly favorable conditions, by one or two sprayings of the trees with one of the lime and sulphur washes. The materials for these washes are not costly, are easily obtained anywhere, are prepared for use by simply boiling them together, and are applied with an ordinary spray pump, such as is commonly used in orchard work.

### **DESTROYING PRAIRIE DOGS.<sup>a</sup>**

The prairie dog is well known to the inhabitants of the western plains. A full description of the animal, its habits, and methods of exterminating it is given by Dr. C. Hart Merriam in the Yearbook of this Department for 1901, page 257. Largely owing to the indifference of nonresident landowners and the destruction of the prairie dogs' natural enemies they have increased so rapidly and are now doing so much damage that an act was passed by the Nebraska legislature for 1903 declaring them to be a nuisance and requiring landowners to take measures for exterminating them. During the same year the Kansas legislature made provision for continuing experiments in the preparation and use of poisons for combating prairie dogs and other injurious rodents. According to Doctor Merriam the number of prairie-dog holes per acre varies from a few up to more than 100 and averages about 25. Near Alma, Nebr., the number of holes ranged from 35 to 64 per acre and at Carlsbad, N. Mex., the number was 50. Prairie dogs cause far more damage than is generally realized. They not only feed upon the native grasses of the range country, in this way destroying so much grass that the carrying capacity of the range is reduced to about 50 per cent of what it otherwise would be, but in the cultivated fields they have also proved very destructive to various crops, including alfalfa, cereals, potatoes, sugar beets, etc.

The treatment which has heretofore proven most effective is the use of strychnin and potassium cyanid. There are, however, many objections to the free use of such deadly poisons as these, and so different methods of fumigation, especially with carbon bisulphid, have been tried.

The use of carbon bisulphid has been found effective, especially with small colonies, but is very laborious and expensive. The Nebraska Station, therefore, attempted to find a cheaper substitute for

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<sup>a</sup> Compiled from Kansas Sta. Bul. 116; Rpt. 1903-4, p. XVII, Nebraska Sta. Bul. 86.

carbon bisulphid. It was found that "light hydrocarbon by-products of Pintsch gas, which cost 7 cents per gallon, will take the place of bisulphid of carbon, which costs the farmers about \$1.10 per gallon." "This substance is a by-product formed in the condensation of Pintsch gas. When the gas is compressed to fill the storage cylinder of the railroad coaches, one-tenth of the entire quantity liquefies. This liquid is useless for illuminating purposes. As it is a constant product of the Pintsch gas factories, we may assume that it will be abundant as long as these factories operate. \* \* \* Its vapors are heavy and readily penetrate into the recesses of the holes. It does not seem to be absorbed as readily by the soil as carbon bisulphid."

The following instructions are given regarding fumigation:

Let one man proceed in advance with a spade and cover up all apparently deserted holes with a sod. He is to be followed by another man who inserts into each remaining hole a cow or horse chip saturated with the hydrocarbon. The third man closes all the treated holes. Working in this way, three, with a boy to run errands, can cover 20 acres of an average dog town per day. After going over the field the first time it is comparatively easy for the owner to drive over it each day carrying a sack of chips, a jug of hydrocarbon, and a spade in his buggy. He can then treat any missed or opened holes in a comparatively short time.

For very large tracts covered by prairie dogs it is probable that a combination of poison and fumigation will prove most economical. Poisoning should be done during the time of year when food is scarce. After distributing the poison once or twice some time should be allowed to elapse. At the end of this time, when unoccupied holes can be readily distinguished from those occupied by dogs, the remaining dogs can be killed by fumigation. About the only advantage in using poison at all is the saving of labor. It seems to be necessary to resort to fumigation in the end to entirely exterminate a colony.

Strychnin seems to have proven the most effective poison. A formula for preparing this poison is given as follows in a bulletin of the Kansas Station:

Dissolve  $1\frac{1}{2}$  ounces of strychnia sulphate in a quart of hot water. Add a quart of sirup—molasses, sorghum, or thick sugar and water—and a teaspoonful of oil of anise. Thoroughly heat and mix the liquid. While hot pour it over a bushel of clean wheat and mix completely. Then stir in 2 or more pounds of fine corn meal. The quantity of corn meal will depend upon the amount of extra moisture present. There should be enough to wet every grain of the wheat and no more. Care should be taken that there is no leakage from the vessel in which the wheat is mixed. Let the poisoned grain stand overnight, and distribute it in the early morning of a bright day. Use a tablespoonful of the wheat to each hole occupied by prairie dogs, putting it near the mouth of the burrow in two to three little bunches. Do not put out the poison in very cold or stormy weather. It will keep for a considerable time, and is much more effective after a cold period, as the animals are then hungry and eat the grain readily. A bushel of wheat should poison 1,000 to 1,200 holes. An excellent substitute for the oil of anise in the above formula can be made by soaking 2

ounces of green coffee berries in the whites of three eggs. Let this stand for about twelve hours and use the liquid instead of anise oil.

Doctor Merriam says "poisons are of very little use except in winter and early spring, when the ordinary food of the prairie dog is scarce and difficult to obtain."

The effectiveness of the systematic crusade against the prairie dog is sufficiently apparent from the fact that in Kansas it is estimated that in 1904 the prairie dogs were destroyed over an area of 700,000 acres at an expenditure of about \$1,000. During the three years in which this work has been carried on nearly three-fifths of the whole infested area of Kansas has been reclaimed from the prairie dogs at a total expense of \$3,000. The Kansas law on this subject requires the township trustees to supervise the field work of killing prairie dogs, and it is estimated that the work is thereby rendered more efficient.

It should be noted that the methods of poisoning and fumigation used in the destruction of prairie dogs are also effective against pocket gophers, field mice, ground squirrels, rabbits, and, to a less extent, rats and moles. Fumigation with the hydrocarbon by-products of Pintsch gas or with carbon bisulphid may be used for animals which live in open burrows, while the poison method may be used for pocket gophers and moles.

### **CLEAN MILK.<sup>a</sup>**

The production of clean milk is of vital importance to infants and invalids and of no little concern to every consumer of this highly nutritious food. It is universally recognized that much of the sickness and many of the deaths of infants are due to impure milk, and it is also quite probable that some of the digestive disturbances of adults may have the same origin. Aside, however, from possible injurious effects, no one would willingly consume milk known to be impure.

It is the purpose of this note to call attention to the nature, extent, and means of prevention of some everyday forms of milk contamination rather than to discuss the transmission of diseases, such as tuberculosis or foot-and-mouth disease, from diseased cows to human beings by means of milk, or outbreaks of such diseases as typhoid fever or diphtheria, which have again and again been traced to the milk supply infected through the ignorance and slovenly habits of persons engaged in this business.

Milk may become contaminated at every stage from production to

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<sup>a</sup> Compiled from Connecticut Storrs Sta. Bul. 25; Illinois Sta. Buls. 91, 92; Michigan Sta. Bul. 221; Nebraska Sta. Bul. 87; New York Cornell Sta. Bul. 203; Pennsylvania Dept. Agr. Bul. 125.

consumption. In the udder of the healthy cow it may acquire a disagreeable odor or taste from the food consumed by the animal or may contain bacteria. Whether or not the latter are invariably present in the normal udder is still a matter of considerable discussion. At any rate these minute forms of plant life spoken of indiscriminately as bacteria, germs, microbes, and micro-organisms are always present in milk as it is usually obtained and bring about in time many changes in the milk, of which souring, due to a decomposition of the milk sugar, with the resulting formation of lactic acid, is the most familiar.

Doubtless the greatest contamination of milk occurs at the time of milking. In the first few streams drawn are always large numbers of bacteria. Dust floating in the air settles in the open pail. The movements of the animal and the manipulations necessary in milking loosen the particles of filth on the udder and adjoining portions of the cow, and they are collected in the pail along with the milk. From the hands and clothing of the milker are added further impurities. When the yards or stables in which the milking is done are filthy, when the air is laden with dust, as is always the case when bedding is supplied or the animals fed just previous to milking, when the cows are covered with dirt from wading in muddy pastures or unclean yards or from lying in the gutter due to faulty construction of stables, and when milkers are slovenly in their habits, the quantity of filth that gets into milk is truly enormous.

In an experiment reported by W. J. Fraser, of the Illinois Station, some figures were obtained as to the amount of dirt falling from udders apparently clean, soiled, and muddy. A dish of the same diameter as an ordinary milk pail was held under an udder for  $4\frac{1}{2}$  minutes, while the milker went through motions similar to those made in milking, but not drawing any milk. The dirt thus collected was thoroughly dried and weighed. As an average of 75 trials made at different seasons of the year it was found that the weight in grams of dirt which fell from udders apparently clean was 0.0152, from udders slightly soiled 0.1316, and from muddy udders 0.8831. From these data it was calculated that from muddy udders 1 ounce of dirt would fall into the milk in 32 milkings, or that every 275 pounds of milk would contain 1 ounce of filth. After each of the above tests the udder was washed and the dirt collected as before. It was found that with udders apparently clean  $3\frac{1}{2}$  times as much dirt fell from the unwashed udders as from the same udders after they were washed. With soiled udders the ratio was 18, and with muddy udders it reached 90.

Conditions favoring the entrance of dirt into milk are also favorable to bacterial contamination. Data obtained at the Illinois Station

on this point may be cited. Dishes having an area of about 10 square inches, and filled with a nutrient medium upon which bacteria grow, were uncovered for about one-half minute under various conditions. The average numbers of colonies which developed in the culture medium, and which corresponded presumably to the number of individual bacteria which fell into the dishes during the exposures, were as follows: Exposure made in open field, 0.9; barnyard, 13; well-kept barn during milking, 32; poorly kept barn during milking, 168; before feeding, 46; after feeding, 109; after brushing cows, 307; under apparently clean udders, 578; under washed udders, 192. This affords some indication as to the effect of some of the different operations commonly performed in dairying upon the bacterial content of the milk.

Similar data have also been reported by A. L. Haecker and C. W. Melick of the Nebraska Station. Petri dishes, as in the above experiments, were exposed under udders which had been (1) sponged with water, (2) sponged with 5 per cent carbolic-acid solution, (3) smeared with vaseline, and (4) merely brushed with the hand. The motions of milking were gone through with, although no milk was drawn. When the exposures were made in the stable the number of colonies which developed in the petri dishes exposed under udders treated with carbolic-acid solution was 344, under udders treated with vaseline 346, under udders treated with water 483, and under udders not treated 20,500. When the exposures were made in the pasture the corresponding numbers were 86, 92, 120, and 310. The value of sponging the udder with water before milking as a means of reducing bacterial contamination is apparent.

It would be an easy matter to multiply almost indefinitely observations on the amount of dirt getting into milk in the ordinary processes of milking and on the extent of bacterial contamination. As the two are more or less closely associated, the number of bacteria indicates to a certain extent the degree of cleanliness employed. This is of especial value in inspection, as the estimation of dirt in milk is somewhat difficult. The filth that gets into milk is to a large extent readily soluble in the milk, and no straining, filtering, or centrifuging can remove it. Following milking, however, the number of bacteria is constantly being increased from unclean and unsterile utensils and apparatus used in straining, cooling, and transporting the milk.

There are, of course, many other ways in which milk may become impure. Exclusive of deliberate adulteration, those mentioned are, however, the most obvious. The greatest amount of dirt comes from the exterior of the cow during milking. Some of the means of producing clean milk may be noted.

By using a covered milk pail, which has been described in a pre-

vious number of this series,<sup>a</sup> W. A. Stocking, jr., of the Connecticut Storrs Station, found that in a dairy where conditions of cleanliness were good 63 per cent of the dirt was excluded. When such dirt was once permitted to get into the milk, less than 47 per cent could be removed by prompt straining. Often the difference was very much greater than the 16 per cent here stated. The covered pail excluded 29 per cent of the total number of bacteria, while prompt straining removed only 11 per cent. The advantages of using a covered milk pail seem apparent from those figures alone.

W. J. Fraser, of the Illinois Station, summarizes some of the means of improving milk supplies as follows:

Keep the cows clean, and do not compel or allow them to wade and live in filth. This means clean yards and clean, well-bedded stalls. Everything short of this is positively repulsive and should not be tolerated any longer in a civilized community.

Stop the filthy practice known as "wetting the teats," by which is meant the drawing of a little milk into the hands with which to wet the teats before and during milking, leaving the excess of filthy milk to drop from the hands and teats into the pail.

Wash all utensils clean by first using lukewarm water, afterwards washing in warm water, and rinsing in an abundance of boiling water, then exposing until the next using in direct sunlight, which is a good sterilizer.

Use milk pails, cans, etc., for no other purpose but to hold milk.

Keep out of these utensils all sour or tainted milk, even after they have been used for the day. Using them for this purpose at any time infects them so badly that no amount of washing is likely to clean them. Bacteria are invisible, and millions can find lodging place in the thin film of moisture that remains after dishes are apparently clean.

Brush down the cobwebs and keep the barn free from accumulations of dust and trash.

Whitewash the barn at least once a year.

C. E. Marshall and W. R. Wright, of the Michigan Station, give the following outline for milk management:

- (1) The cow should be sound—no disease should exist in the animal.
- (2) The feed should be good and free from aromatic substances. If these aromatic foods are used, they should be employed according to those methods which will not cause odors or flavors to appear in the milk.
- (3) The cow should be groomed and hair about the udder preferably clipped.
- (4) The udder should be moistened during milking.
- (5) The milker should be a neat, tidy person.
- (6) The milker should be free from disease and should not come in contact with any communicable disease.
- (7) The milker's hands and clothes should be clean while milking.
- (8) The pail should be sterilized.
- (9) The stall should be such as to reduce the amount of disturbance of dust and dirt.
- (10) There should be good light, good ventilation, and good drainage in the stable.

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<sup>a</sup> U. S. Dept. Agr., Farmers' Bul. 210, p. 26.

- (11) The stable should always be kept clean.
- (12) Feeding and bedding, unless moist, should be done after milking.
- (13) A dustless milking room is desirable.
- (14) Milk should not stand in the stable.
- (15) If milk is aerated, it should be done before cooling and in pure air.
- (16) The sooner the milk is cooled after milking the better.
- (17) Keep the milk as cold as possible when once cooled.

O. F. Hunziker, of the New York Cornell Station, summarizes a bulletin on the care and handling of milk as follows:

The greater the attention paid to scrupulous cleanliness in handling milk at all stages, the shorter the time that elapses between the drawing, straining, and cooling of milk, and the lower the temperature to which it is cooled, the greater its freedom from micro-organisms, the longer it will retain its normal condition, the more profitable its production will be, and the more wholesome will it be for old and young.

D. H. Bergey, of the University of Pennsylvania, says:

The conditions in a dairy which appear to be necessary to produce a milk which is satisfactory in respect to its bacterial content may be stated as follows:

- (1) The selection of cows free from inflammatory disease of the udder.
- (2) Housing the cows in clean, well-ventilated stables, with nondust-producing bedding.
- (3) The systematic daily cleaning of the cows with currycomb and brush and the washing of the udder and flanks with clean warm water a short time before each milking.
- (4) The careful regulation of the diet and physical condition of the cows, so as to maintain their health.
- (5) The selection of efficient milkers and attendants who will faithfully carry out the minutest details of the regulations necessary to produce pure milk.
- (6) The provision of flowing water, soap, and towels, to permit the milkers to wash and scrub their hands after milking each cow.
- (7) The provision of freshly laundered cotton slips and caps, to be worn by the milker over his regular clothing.
- (8) The sterilization by means of steam of the various milking, straining, cooling, and bottling apparatus before each milking.
- (9) The rapid cooling and bottling of the milk, so as to remove it permanently from contact with air at the earliest possible moment. The milk should be cooled to about 40° F. before it is bottled.
- (10) The transportation and storage of milk in such a manner as to prevent its temperature rising much above the point to which it has been cooled during transportation, so that it may reach the consumer without undergoing any alteration.

## CONSTRUCTION AND VENTILATION OF POULTRY HOUSES.<sup>a</sup>

As an incident to poultry investigations of various kinds which have been conducted by a number of experiment stations considerable attention has been given to the construction of poultry houses and the amount of space per fowl which will give best results as

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<sup>a</sup> Compiled from Maine Sta. Bul. 100.

regards health and productive capacity. For example, in a series of experiments made at the Maine Station, which have been noted in a previous bulletin of this series,<sup>a</sup> it was shown that the best results were obtained by providing from 8 to 10 feet of floor space for each hen.

There is great difference of opinion as to the best method of calculating the number of fowls a poultry house will accommodate. The common method of calculation is based upon floor space, the height being considered immaterial. Houses built on this principle are low, and consequently the least expensive that can be constructed. Another method of calculation is based upon the amount of perch room, while a third is based upon the volume or cubic contents. Various poultrymen recommend 6, 8, and 10 cubic feet of space per fowl.

In view of the widely divergent views on this subject and the lack of definite knowledge K. J. J. Mackenzie and C. S. Orwin,<sup>b</sup> of the Southeastern Agricultural College of England, undertook a series of experiments to more definitely determine the amount of air space required by poultry. They studied the frequency and rate of respiration in fowls, the amount of carbon dioxide thrown off, the amount of vitiation of the air which the fowls could stand without injury, and examined different types of poultry houses with reference to their suitability for furnishing proper conditions of ventilation. Assuming that the air of poultry houses should not contain more than 9 parts of carbon dioxide per 10,000 of air they estimated that each fowl must be supplied with about 40 cubic feet of air per hour, the requirements of small fowls being practically the same as of large.

In wooden poultry houses with ventilation at the top the air apparently changes about four times per hour. Each bird must therefore have 10 or more cubic feet allotted to it.

The number of birds a house will hold depends on its volume and not on the floor space or perch room. The maximum number is found by dividing the volume expressed as cubic feet by ten. We prefer to keep within this number.

The greatest capacity can be most economically obtained from a given amount of timber if the house is cubical in shape. This can not be quite realized in practice owing to the necessity for a sloping roof, but the nearer one gets to it the better.

Low houses, besides being uneconomical, tend to induce overcrowding.

Overcrowding causes diminished egg production and encourages roup, tuberculosis, and other diseases.

The atmosphere in a long, low house with the bottom out is about twice as good as one with the bottom in. The air changes about twice as quickly, and it would appear this must be accompanied by a draft.

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<sup>a</sup> U. S. Dept. Agr., Farmers' Bul. 114, p. 18.

<sup>b</sup> Jour. Southeast. Agr. Col., Wye, 1904, No. 13, p. 84.

Excellent results, both as regards ventilation and warmth, have been secured at the Maine Station by the use of the curtained front poultry house with curtained roosting closets shown in figures 1 and 2. This building is 14 feet wide and 150 feet long.

The back wall is  $5\frac{1}{2}$  feet high from floor to top of plate inside, and the front wall is  $6\frac{3}{4}$  feet high. The roof is of unequal span, the ridge being 4 feet in from the front wall. The height of the ridge above the floor is 9 feet. The sills are 4 by 6 inches in size and rest on a rough stone wall laid on the surface of the ground. A central sill gives support to the floor, which at times is quite heavily loaded with sand. The floor timbers are 2 by 8 inches in size and are placed 2 feet apart. The floor is two thicknesses of hemlock boards. All of the rest of the frame is of 2 by 4 inch stuff. The building is boarded, papered, and shingled on roof and walls. The rear wall and 4 feet of the lower part of the rear roof are ceiled on the inside of the studding and plates and packed

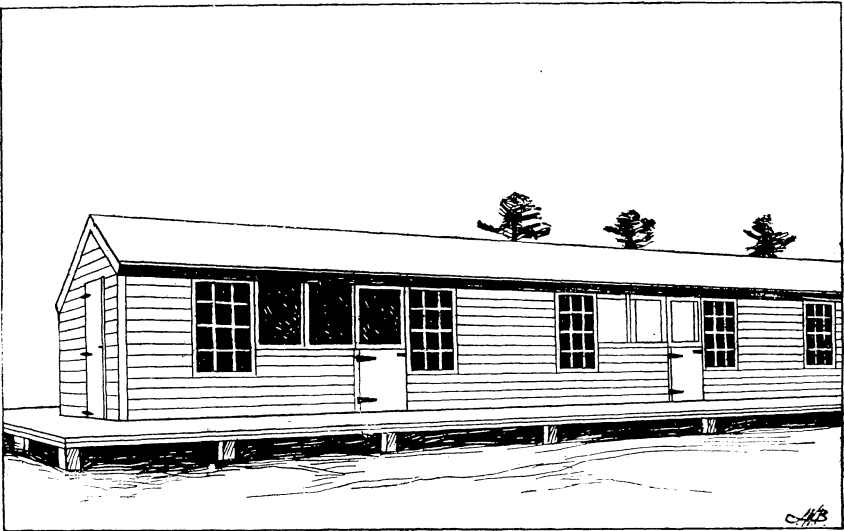


FIG. 1.—Two sections of curtain-front poultry house.

very hard with dry sawdust. In order to make the sawdust packing continuous between the wall and roof, the wall ceiling is carried up to within 6 inches of the plate, then follows up inclining pieces of studding to the rafters.

The short pieces of studding are nailed to the studs and rafters. By this arrangement there are no slack places around the plate to admit cold air. The end walls are packed in the same way. The house is divided by close board partitions into seven 20-foot sections; and one 10-foot section is reserved at the lower end for a feed storage room.

Each of the 20-foot sections has two 12 light, outside windows screwed onto the front, and the space between the windows, which is 8 feet long and 3 feet wide down from the plate, is covered during rough winter storms and cold nights by a light frame covered with 10-ounce duck closely tacked on. This door or curtain is hinged at the top and swings in and up to the roof when open.

A door  $2\frac{1}{2}$  feet wide is in the front of each section. The roost platform is at the back side of each room and extends the whole 20 feet. The platform is

3 feet 6 inches wide and is 3 feet above the floor. The roosts are of 2 by 3 inch stuff placed on edge and are 10 inches above the platform. The back one is 11 inches out from the wall and the space between the two is 16 inches, leaving 15 inches between the front roost and the duck curtain, which is sufficient to prevent the curtain being soiled by the birds on the roost. The two curtains in front of the roost are similar to the one in the front of the house. They are each 10 feet long and 30 inches wide, hinged at the top, and open out into the room and fasten up when not in use. Great care was exercised in constructing the roosting closets to have them as near air-tight as possible, excepting what may be admitted through the cloth curtain.

Single pulleys are hung at the rafters and, with half inch rope fastened to the lower edge of the curtain frames, they are easily raised or lowered and kept in place. At one end of the roosts a space of 3 feet is reserved for a cage for broody hens. This being behind the curtain, the birds have the same night temperature when they are transferred from the roosts to the cage. Six trap nests are placed at one end of each room and four at the other. (Fig. 2.)

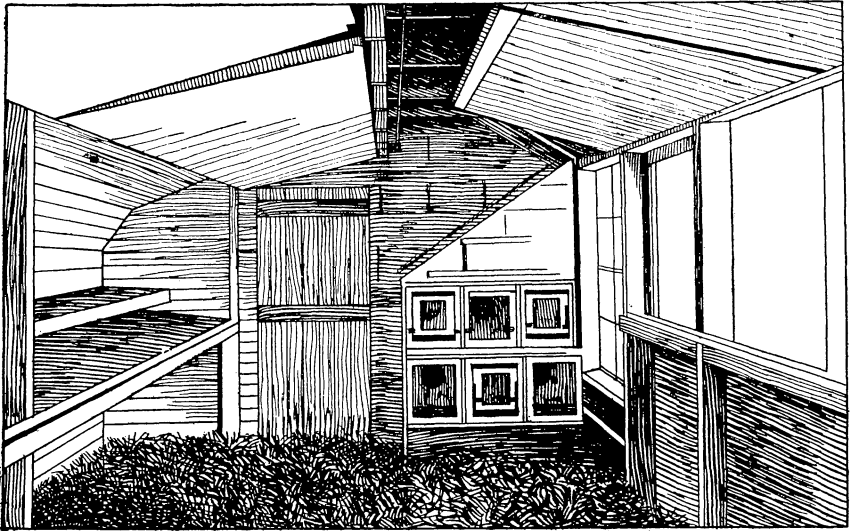


FIG. 2.—Interior of one section of curtain-front house, showing also trap nests in one corner.

They are put near the front, so that the light may be good for reading and recording the number on the leg bands of the birds. Several shelves are put on the walls  $1\frac{1}{2}$  feet above the floor for shell, grit, bone, etc. The doors which admit from one room to another throughout the building are frames covered with 10-ounce duck, so as to make them light. They are hung with double-acting spring hinges. The advantages of having all doors push from a person are very great, as they hinder the passage of the attendant with his baskets and pails very little. Strips of old rubber belting are nailed around the studs, which the doors rub against as they swing to, so as to just catch and hold them from opening too easily by the wind. Tight board partitions were used between the pens instead of wire, so as to prevent drafts. A platform 3 feet wide extends across both ends and the entire front of the building outside.

The house is well made of good material and should prove to be durable.

It costs about \$850. A rougher building with plain instead of trap nests, with the roof and walls covered with some of the prepared materials, instead of shingles, could be built for less money, and would probably furnish as comfortable quarters for the birds for a time as this building will.

This house accommodates 350 hens—50 in each 20-foot section.

Even in very severe weather when the temperature at night was considerably below zero and rose but little above it during the day, with high winds, the bedding on the floor and the roosting closets remained dry and free from offensive odors. The fowls laid as well as their mates in a large warmed house, their combs were red and their plumage bright, and they gave every evidence of perfect health and vigor. "The birds seemed to enjoy coming out of the warm sleeping closet down into the cold straw, which was never damp, but always dry, because the whole house was open to the outside air and sun every day. There were no shut-off corners of floor or closet that were damp." No cases of cold or snuffles developed among the fowls.

It is customary to have the yards on the south or sheltered side of poultry houses to afford protection during late fall and early spring, when cold winds are common. With the curtained-front house north yards only are to be used, it being believed that the necessity for getting the fowls as soon as possible out of the open-front house where they are really subject to most of the out-of-door conditions during the daytime is not so great as when they are confined in closed houses with walls and glass windows. "The clear open front of the house allows teams to pass close to the open door of the pens for cleaning out worn material and delivering new bedding, and also in allowing attendants to enter and leave all pens from the outside walk, and reach the feed room without passing through intervening pens."